No. 4472

Operating Instructions

D.C. MULTIPLIER TYPE TM.5033A.

S/N JA344/11

MARCONI INSTRUMENTS LIMITED, ENGLAND

OPERATING INSTRUCTIONS

No. EBM 5031A-5033A

for

COAXIAL T-CONNECTOR TYPE TM 5031A,

A.C. MULTIPLIER TYPE TM 5032,

and D.C. MULTIPLIER TYPE TM 5033A.

NOTE:- (Applicable only when D.C. Multiplier is supplied)

The data entered on page 5 of this handbook refers to D.C. Multiplier Serial No. JA 344/11

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SCHEDULE OF PARTS SUPPLIED

The following items are supplied, separately or collectively, as ordered:-

1.	One:	Coaxial T-Connector Type TM 5031A.
2.	One:	A.C. Multiplier Type TM 5032.
3.	One:	D.C. Multiplier Type TM 5033A, complete with Connector Type TM 5749.
4.	One:	Carrying Case Type TM 4935.

1. DESCRIPTION

1.1. GENERAL

These three accessories, which are designed for use with the Marconi Vacuum Tube Voltmeter Type TF 1041B, are supplied separately or as a set. They comprise the following items:-

(1) Coaxial "T" Connector Type TM 5031A.
(2) A.C. Multiplier Type TM 5032.
(3) D.C. Multiplier Type TM 5033A.

The A.C. and D.C. Multipliers may also be used with the two earlier models in the 1041 series of Voltmeters, namely the TF 1041 and the TF 1041A. The T-Connector may be used with the TF 1041A but is not electrically suitable for the TF 1041.

For stowing the accessories when not in use there is also a polished hardwood carrying case, Type TM 4935.

1.2. COAXIAL T-CONNECTOR TYPE TM 5031A

This attachment enables the Voltmeter to be used for making voltage measurements on 50-ohm coaxial cables without introducing any appreciable discontinuity.

The horizontal arm of the Tee is, in effect, a short section of transmission line formed by a centre conductor in a brass block, and is terminated with a Type N plug at one end and a Type N socket at the other. The vertical arm comprises a receptacle into which the a.c. probe of the Voltmeter can be plugged. The T-Connector is designed to have a characteristic impedance of 50 ohms when the probe is inserted.

1.3. A.C. MULTIPLIER TYPE TM 5032

The A.C. Multiplier extends the a.c. measurement range of the Voltmeter to 2 kV r.m.s. at frequencies of 10 kc/s and above. It comprises a capacitive voltage divider and takes the form of a plug-on cap which fits over the normal a.c. probe of the Voltmeter. The voltage reduction ratio is 100:1 and the capacitance placed across the circuit under test is about 2 $\mu\mu$F.

1.3. (continued)

The voltage divider is formed by two capacitors, of approximately 1 μμF and 100 μμF. The smaller capacitor is of piston-and-cylinder construction; during factory calibration its capacitance is adjusted, by altering the piston insertion, to give a voltage reduction ratio of exactly 100:1. The larger capacitor is of disc-type construction, using Melinex as the dielectric material.

1.4. D.C. MULTIPLIER TYPE TM 5033A

The D.C. Multiplier is used to extend the d.c. measurement range of the Voltmeter to 30 kV. It comprises a series resistance for connection between the high-voltage source and the Voltmeter input and, in conjunction with the Voltmeter input resistance, forms a potential divider with a voltage reduction ratio of 30:1 in the case of the TF 1041B, or 150:1 with the TF 1041 or TF 1041A. Individual Multipliers may be used with any individual Voltmeter.

Three 1,000-MΩ resistors are connected in series between the ends of the Multiplier. The resistors are embedded in an epoxy-resin moulding within a tubular s.r.b.p. casing; a safety ring confines the hand to the low-potential end of the Multiplier.

The live end of the Multiplier is fitted with a conducting spike for making contact with the high-voltage source. The other end has a plug which mates with one end of Connector TM 5749, which in turn engages the d.c. probe of the TF 1041B Voltmeter. In the case of the TF 1041 or TF 1041A Voltmeters, the Multiplier plug mates directly with one of the sockets of the Voltmeter d.c. measuring leads without using Connector TM 5749.

2. OPERATION

2.1. COAXIAL T-CONNECTOR TYPE TM 5031A

Insert the a.c. probe into the T-Connector so that the probe point engages in the hole in the T-Connector centre conductor; push home until the lip of the receptacle on the T-Connector engages in the corresponding groove encircling the ground band of the probe.

The general measurement procedure is similar to that described for a.c. voltage measurement in the TF 1041B or TF 1041A handbook. The v.s.w.r. introduced by the T-Connector is virtually unity at low frequencies and rises to approximately 1.1 at 800 Mc/s.

The T-Connector is not suitable for use with the A.C. Multiplier.

2.2. A.C. MULTIPLIER TYPE TM 5032

Insert the a.c. probe into the Multiplier, taking care that the probe point engages in its mating socket in the Multiplier, and push home unitl the lip of the Multiplier skirt engages in the groove encircling the ground band of the a.c. probe. The cylindrical ground connector supplied with the Voltmeter should be fitted to the Multiplier to act as an electrostatic shield, and ground connection should be made by fitting the normal ground clip to the Multiplier skirt. The general measuring procedure is similar to that described for a.c. voltage measurement in the Voltmeter handbook, the unknown voltage being determined by multiplying the Voltmeter indication by 100.

The Multiplier must not be used to measure voltages with a peak value greater than 2.8 kV; when measuring a.c. voltages superimposed on d.c., the peak value of the a.c. voltage plus the standing d.c. or mean voltage must not sxceed 2.8 kV.

The shunting effect of the Voltmeter input resistance across the 100-μμF capacitor in the Multiplier is negligible except at low frequencies, at which the reactance of the capacitor becomes significant; this causes a falling-off in accuracy of the voltage reduction ratio and sets a low-frequency limit of 10 kc/s. Although the voltage reduction ratio is maintained well into the u.h.f. range, the measurement accuracy becomes unreliable above about 10 Mc/s as a result of the

2.2. (continued)

large field normally produced by the apparatus under test. For this reason, the Multiplier is not recommended for accurate measurement above 10 Mc/s except, possibly, where the apparatus under test is effectively screened.

It should be noted that, unlike the Voltmeter probe, the point of the Multiplier is not detachable; the threaded section which passes through the tapped insert in the polystyrene cap, and is secured by the lock-nut, provides the means of setting up the voltage reduction ratio and consequently must not be disturbed except for recalibration purposes.

2.3. D.C. MULTIPLIER TYPE TM 5033A

2.3.1. Used with Voltmeter Type TF 1041B

The Multiplier can be fitted to the d.c. probe of the Voltmeter by using Connector TM 5749. The general measurement procedure is then similar to that described for d.c. measurement in the TF 1041B handbook.

WARNING The Voltmeter d.c. measuring circuit is isolated from chassis; to avoid the possibility of insulation breakdown, it is therefore essential to connect the Common lead before the Multiplier lead.

Under ideal conditions there is no danger of shock when the Multiplier is gripped between the guard ring and the low-potential end; even if the connector at the low-potential end is touched when the Voltmeter probe has become disconnected the shock experienced will be, at worst, very slight. However, in view of the difficulty of ensuring that the Multiplier is kept perfectly clean and dry, and also to allow for the possibility of internal breakdown, the user is strongly advised not to handle the Multiplier when it is in contact with lethal voltages. Under no circumstances must the Multiplier be used to measure voltages greater than 30 kV.

By applying the nominal multiplying factor of x30 to the Voltmeter indication, high voltages can be measured with an accuracy of the order of 5%. A greater accuracy will be obtained by taking account of the

2.3.1. (continued)

individual values of Multiplier resistance (Rm) and Voltmeter d.c. input resistance (Rv) in order to determine the exact multiplying factor for each combination of Voltmeter and Multiplier. If this is done the measurement accuracy will be increased to approximately 3%.

The exact multiplying factor, M, can be calculated from the expression

$$M = \frac{Rm + Rv}{R_v}$$

where Rm = Multiplier resistance in megohms,

and Rv = Voltmeter d.c. input resistance in megohms.

The resistance values appropriate to each Multiplier and Voltmeter are measured and recorded during factory calibration; the value of Rm for the Multiplier with which this particular handbook is issued is given below; the value of Rv is given in the handbook for the TF 1041B Voltmeter.

Multiplier Serial No ..JA 344/11.....

Resistance, Rm .....2900..... MΩ.

2.3.2. Used with Voltmeter Type TF 1041 or TF 1041A

With these earlier types of Voltmeter, the Multiplier can be fitted directly to the DC+VE or DC-VE lead of the Voltmeter, in accordance with the polarity of the voltage under test. The general measurement procedure is then similar to that described for d.c. measurement in the TF 1041 or TF 1041A handbook, except that measurement can only be made with respect to ground; balanced or differential voltages cannot be measured directly when using the Multiplier.

The nominal multiplying factor with either of these Voltmeters is x150; the exact factor can be calculated as in Section 2.3.1 above. With early models of the TF 1041 it will be found that no individual input resistance figure is quoted; in such cases a figure of 19.8 MΩ may be assumed without serious loss of accuracy.

The 30-kV voltage limitation and the handling precautions stated in Section 2.3.1 must still be observed.

3. MAINTENANCE

3.1. A.C. MULTIPLIER TYPE TM 5032

3.1.1. Apparatus Required

(a) Beat Frequency Oscillator, Marconi Type TF 195M.

(b) Vacuum Tube Voltmeter, Marconi Type TF 1041, standardized at 50 volts and 0.5 volts a.c.

3.1.2. Adjustment of Voltage Reduction Ratio

The ratio can be checked by measuring an arbitrary fixed voltage using (1) the TF 1041 Voltmeter alone, and (2) the Voltmeter with the Multiplier attached. Adjustment is made by rotating the Multiplier point in its tapped insert after loosening the lock-nut; if necessary, the sealing varnish may be softened by means of a solvent such as methylated spirits.

The procedure for checking and adjusting is as follows:-

(1) Apply a signal of about 35 kc/s to the voltmeter probe and adjust the signal level for a Voltmeter reading of 50 volts.

(2) Fit the Multiplier to the Voltmeter probe and check that the Voltmeter indication drops by a factor of 100, i.e. to 0.5 volt.

(3) Adjust the ratio, if necessary, by rotating the Multiplier point, re-tightening the lock-nut after each adjustment. The lock-nut should finally be sealed with varnish.

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